

APPENDIX B

**AN EXPLANATION FOR DIFFERENCES IN REPORTED RESULTS BETWEEN THE
PRESENT STUDY AND THOSE OF KERLINGER AND CURRY (2003), PLUS
IDENTIFICATION OF EXPERIMENTAL DESIGN SHORTFALLS IN BOTH**

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Reporting

Kerlinger and Curry's analysis relied on the Wildlife Reporting and Response System (WRRS) for raptor fatality information, but the WRRS is indefensible as a scientific monitoring program. It relies almost entirely on volunteer reporting of bird carcasses discovered incidentally by turbine maintenance workers performing maintenance or repair services at wind turbines. The WRRS database is a collection of fatality data collected without a systematic approach or sampling scheme. It reflects where maintenance workers incidentally encounter dead birds, not where birds are actually killed, throughout the APWRA. During our study we never observed turbine workers searching for carcasses in any way. We have to assume that they reported only the carcasses they happened to see while performing their monitoring and repair services.

Kerlinger and Curry (2003) claim that the WRRS is as efficient as most systematic studies, and this claim is the major premise of their 2003 report, which is a false assertion leading to faulty analyses of their results. Unfortunately, Kerlinger and Curry only presented mortality estimates for golden eagles and red-tailed hawks. Compared to earlier, less robust estimates made by researchers in the APWRA, the WRRS fell short as a reliable monitoring program. The Howell and DiDonato (1991) rate of red-tailed hawk fatalities was 4.77 times greater than the WRRS rate, and the rate of golden eagle fatalities was 1.36 times greater. The Orloff and Flannery (1992) rate of red-tailed hawk fatalities was 5.45 times greater than the WRRS rate, and the rate of golden eagle fatalities was 2.55 times greater. Compared to Howell and DiDonato (1991), the WRRS missed 68 (79%) of the red-tailed hawks and 5 (26%) of the golden eagles per year among the 3,412 turbines in the WRRS. Compared to Orloff and Flannery (1992), the WRRS missed 67 (82%) of the red-tailed hawks and 18 (60%) of the golden eagles per year among the 3,412 turbines.

Compared to our mortality estimates for the entire APWRA, Kerlinger and Curry (2003) also underestimated mortality. Our estimate of red-tailed hawk mortality was 3.8 to 5.5 times greater than the WRRS rate, and our estimate of golden eagle mortality was 2.4 to 3.7 times greater. Compared to our study, the WRRS failed to report 154 (74%) to 245 (82%) of the red-tailed hawk fatalities and 45 (59%) to 86 (74%) of the golden eagle fatalities per year. Missing 74% to 82% of the red-tailed hawk fatalities and 59% to 74% of the golden eagle fatalities is alarming, because the carcasses of these species typically are large and remain recognizable in the field for months. Most likely, the WRRS error rates for smaller-bodied species are very large, but even for red-tailed hawk and golden eagle they are too large to consider the WRRS a reliable monitoring program that can lead to robust mortality estimates.

¹ See references to this appendix in Chapter 6.

Road Surveys

Road surveys were performed to enumerate ground squirrels, but we believe that road surveys are not as reliable as the mapping and enumeration of burrow system centroids (i.e., the approximate centers of burrow systems as viewed on the ground surface) that we performed during our study.

Confounding Factors

Rodent control intensity graded strongly across Kerlinger and Curry's sampling sites, with all the low -intensity rodent control located among the northwest sampling sites, all the medium- intensity rodent control located among the central sampling sites, and all the high- intensity rodent control located among the southern sampling sites. This strong gradient in rodent control intensity across Kerlinger and Curry's sampling sites is a form of pseudoreplication (Hurlbert 1984), and poses the strong likelihood that Kerlinger and Curry's results were confounded by one or more unmeasured factors.

One confounding factor might be inherent geographic differences in intensity of use of the APWRA by species of raptor. It is well documented, for example, that golden eagles mostly occur to the northwest and to the south of the APWRA, and telemetry results indicate that most of the golden eagle forays into the APWRA are from the nesting areas to the northwest and south of the APWRA (Hunt 2002). These forays might have more to do with the convenience of foraging close to natal areas than to the eagles' enumeration of prey.

Another confounding factor is the gradient of wind turbine types and spatial arrangements occurring north-to-south across the APWRA. Mostly well-spaced tubular towers dominate the northeastern portion of the APWRA; whereas, well-spaced tubular towers and lattice towers dominate the northwest aspect, nearly all vertical- axis turbines are located in the central aspect, and tightly grouped tubular towers and lattice towers arranged in wind walls are more common in the southern aspect. This gradient is significant because golden eagles are killed disproportionately more often at wind turbines that are mounted on tubular towers and at wind turbines that are well spaced apart. Raptors are killed less often than expected by chance in crowded wind turbine fields and at wind walls, which happen to be more common in the southern aspect of the APWRA, where the high-intensity rodent control was represented in Kerlinger and Curry's study.

Our study also was prone to confounding due to a gradient in rodent control intensity across the APWRA, but much less so than was Kerlinger and Curry's study. Our samples within areas of no rodent control were more interspersed within the other rodent control treatment intensities, and our samples within areas of intense control were also more interspersed with the other treatments. Had we been granted access to all the wind turbines earlier during the study, we could have achieved a much greater degree of treatment interspersion.

Yet another confounding factor might be the greater need for maintenance of wind turbines in the south versus the north of the APWRA, due to differences in composition of wind turbine type, as an example. Should turbine workers spend more time in one part of the APWRA over another, then the WRRS will reflect different mortalities, accordingly.

Fatality Rates

Fatality rates were compared between rodent control intensities using chi-square tests, which are ill-suited for comparison of rates.

Comparisons of Mortality

Multiple comparisons of mortality were made in the absence of associated error terms or statistical tests results. Small differences in mortality were identified as significant, but again, without the use of error terms or inferential statistics.

BACI Design

The Kerlinger and Curry analysis lacks a before-after, control-impact (BACI) design, which means it cannot distinguish variation in mortality due to rodent control as opposed to other potentially confounding factors. Our study suffers this same design shortfall. A consequence of this shortfall is the inability to conclude with *high* confidence the effects of the rodent control program. The most convincing way to have concluded that the rodent control program had the desired effect in the absence of a BACI design would have been if our data had demonstrated a *substantial* shift in effect (e.g., 80- to 90%); the results of both research efforts fail to meet this criterion.